Exam: EVEN_SEM_ESE_25-26 | Course Year: FY B Tech | Show | Clear

Regular
Start Date : 6/20/0026 12:00:00 AM
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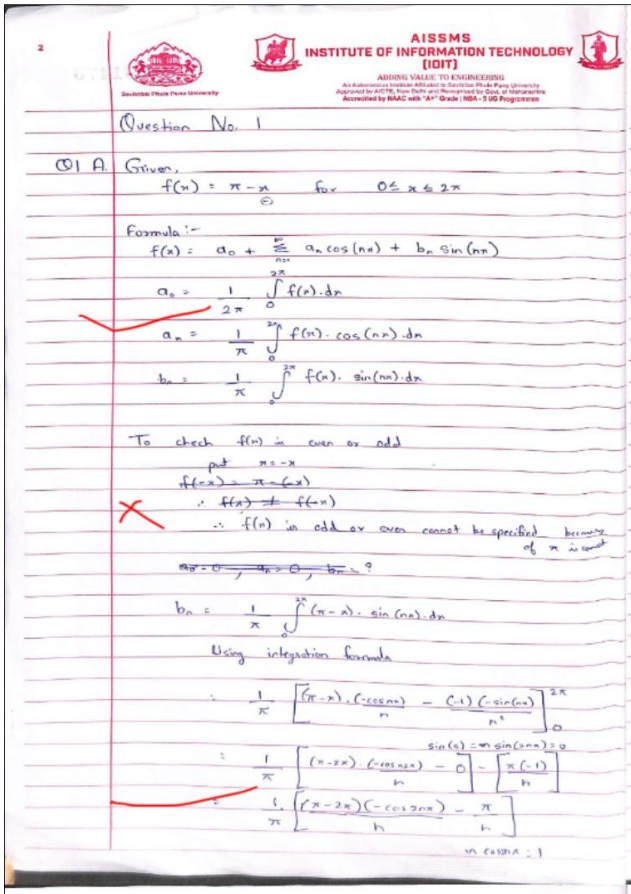
Subject List for Photo Copy

Subjects
Engineering Mathematics - I
Basic Mechanical Engineering
Engineering Mathematics-II
Industrial Chemistry
Basic Electrical Engineering

Que	Que Marks	Obt. Marks
Q.1 A)	5	2
Q.1 B)	5	N
Q.1 C)	5	5
Q.1 D)	5	4
Q.2 A)	5	0



Question No. 1

Q1 A. Given, $f(x) = \pi - x$ for $0 \le x \le 2\pi$

Formula :-

$$f(x) = a_0 + \sum_{n=1}^{\infty} a_n \cos(nx) + b_n \sin(nx)$$

$$a_0 = \frac{1}{2\pi}\int_0^{2\pi} f(x)\,dx$$

$$a_n = \frac{1}{\pi}\int_0^{2\pi} f(x)\cdot\cos(nx)\,dx$$

$$b_n = \frac{1}{\pi}\int_0^{2\pi} f(x)\cdot\sin(nx)\,dx$$

To check $f(x)$ is even or odd

put $x = -x$

$f(-x) = \pi - (-x)$

$\therefore f(x) \neq f(-x)$

$\therefore f(x)$ is odd or even cannot be specified because of π is constant

$a_0 = 0$, $a_n = 0$, $b_n = ?$

$$b_n = \frac{1}{\pi}\int_0^{2\pi} (\pi - x)\cdot\sin(nx)\,dx$$

Using integration formula

$$= \frac{1}{\pi}\left[(\pi - x)\cdot\frac{(-\cos nx)}{n} - \frac{(-1)(-\sin(nx))}{n^2}\right]_0^{2\pi}$$

$\sin(0) = n\sin(2n\pi) = 0$

$$= \frac{1}{\pi}\left[\frac{(\pi - 2\pi)(-\cos 2n\pi)}{n} - 0\right] - \left[\frac{\pi(-1)}{n}\right]$$

$$= \frac{1}{\pi}\left[\frac{(\pi - 2\pi)(-\cos 2n\pi)}{n} - \frac{\pi}{n}\right]$$

$n\cos n\pi = 1$

$$\therefore b_n = \frac{1}{\pi n}\left[(1-2)(-(-1)^2) - 1\right]$$

$$= \frac{1}{n}[0]$$

$\therefore b_n = 0$

$$a_n = \frac{1}{\pi}\int_0^{2\pi} (\pi - x)\cdot\cos(nx)\,dx$$

$$= \frac{1}{\pi}\left[(\pi - x)\frac{\sin nx}{n} - \frac{(-1)(-\cos nx)}{n^2}\right]_0^{2\pi}$$

$$= \frac{1}{\pi}\left[(\pi - 2\pi)\frac{\sin 2n\pi}{n} + \frac{\cos 2n\pi}{n^2}\right] - \left[\frac{(-1)\cos 0}{n^2}\right]$$

$$= \frac{1}{\pi}\left[-\pi \times 0 + \frac{1}{n^2} + \frac{1}{n^2}\right]$$

$$a_n = \frac{2}{n^2\pi}$$

$$a_0 = \frac{1}{2\pi}\int_0^{2\pi} \pi - x\,dx$$

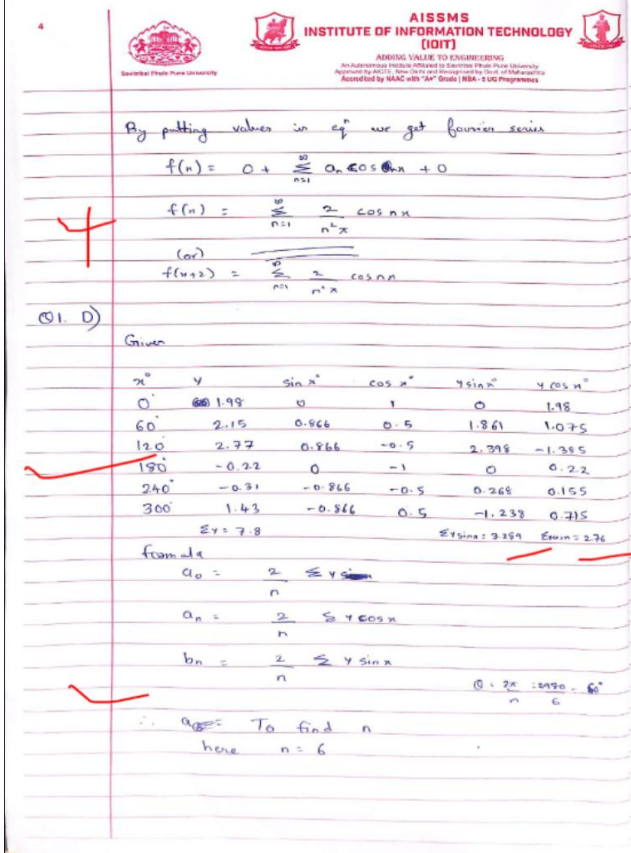
$$= \frac{1}{2\pi}\left[\pi x - \frac{x^2}{2}\right]_0^{2\pi}$$

$$= \frac{1}{2\pi}\left[2\pi^2 - \frac{4\pi^2}{2}\right]$$

$$= \frac{1}{2\pi}[0]$$

$a_0 = 0$ //

$\therefore a_0 = 0$ & $b_n = 0$



By putting values in eq^n we get fourier series

$$f(x) = 0 + \sum_{n=1}^{\infty} a_n \cos nx + 0$$

$$f(x) = \sum_{n=1}^{\infty} \frac{2}{n^2\pi}\cos nx$$

(or)

$$f(x+2) = \sum_{n=1}^{\infty} \frac{2}{n^2\pi}\cos n\pi$$

Q1. D)

Given

x°	y	$\sin x^\circ$	$\cos x^\circ$	$y\sin x^\circ$	$y\cos x^\circ$
0°	1.98	0	1	0	1.98
60°	2.15	0.866	0.5	1.861	1.075
120°	2.77	0.866	-0.5	2.398	-1.385
180°	-0.22	0	-1	0	0.22
240°	-0.31	-0.866	-0.5	0.268	0.155
300°	1.43	-0.866	0.5	-1.238	0.715
	$\Sigma y = 7.8$			$\Sigma y\sin x = 3.289$	$\Sigma y\cos x = 2.76$

formula

$$a_0 = \frac{2}{n}\Sigma y$$

$$a_n = \frac{2}{n}\Sigma y\cos x$$

$$b_n = \frac{2}{n}\Sigma y\sin x$$

$\therefore$ To find n

here $n = 6$

$\frac{2\pi}{n} = \frac{2\pi}{6} = 60°$

$$\therefore a_0 = \frac{2}{6}(7.8) = 2.6$$

$$a_n = \frac{2}{6} \times (2.76) = 0.92$$

$$b_n = \frac{2}{6}(3.289) = 1.096$$

$a_1 = 0.92$

$b_1 = 1.096$

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n\cos x + b_n\sin x$$

$$f(x) = 2.6 + \sum_{n=1}^{\infty} 0.92\cos x + 1.096\sin x$$

Q1 B) Given, $f(x) = \pi x$, $-1 \le x \le 1$

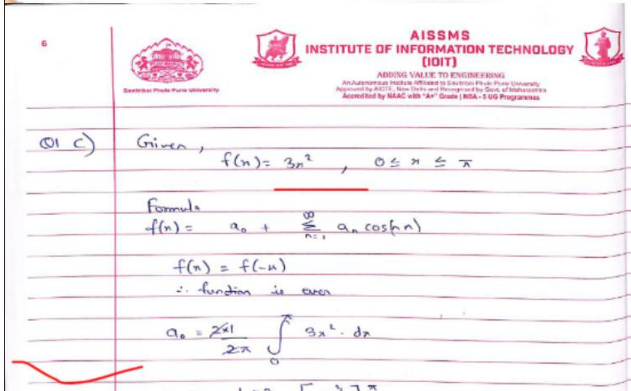
formula

$$f(x) = a_0 + \sum_{n=1}^{\infty} a_n\cos\left(\frac{n\pi x}{l}\right) + b_n\sin\left(\frac{n\pi x}{l}\right)$$

$$a_0 = \frac{1}{2\pi}\int_{-1}^{1} f(x)\,dx$$

$$= \frac{2\pi}{2\pi}\int_{-1}^{1}$$

(continued by)



Q1 C) Given, $f(x) = 3x^2$, $0 \le x \le \pi$

Formula

$$f(x) = a_0 + \sum_{n=1}^{\infty} a_n\cos(nx)$$

$f(x) = f(-x)$

$\therefore$ function is even

$$a_0 = \frac{2\int_0^{\pi} 3x^2\,dx}{2\pi}$$

$$\left[\frac{3f(0)\sin(0)}{n} + 6\times 0 - 6\times 0\right]$$

Calculating it we get

$$a_n = \frac{2}{\pi}\left[\frac{6\pi(-1)^n}{n^2}\right]$$

$$a_n = \frac{12(-1)^n}{n^2}$$

$\therefore$ Half range cosine series :-

$$a_0 = \frac{1}{\pi}\left[\frac{x^3}{3}\right]_0^{\pi}$$

$$a_0 = \frac{\pi}{\pi}\left[\frac{\pi^3}{3}\right]$$

$$\therefore a_0 = \pi^2$$

$$a_n = \frac{2}{\pi}\int_0^{\pi} f(x).\cos(nx).dx$$

$$= \frac{2}{\pi}\int_0^{\pi} 3x^2.\cos(nx).dx$$

$$= \frac{2}{\pi}\left[\frac{3x^2\sin(nx)}{n} - \frac{6x(-\cos(nx))}{n^2} + \frac{6(-\sin(nx))}{n^3}\right]_0^{\pi}$$

$$= \frac{2}{\pi}\left[\frac{3x^2\sin(nx)}{n} + \frac{6x(\cos(nx))}{n^2} - \frac{6\sin nx}{n^3}\right]_0^{\pi}$$

[$\because \sin n\pi = 0$ & $\cos n\pi = (-1)^n$]

Substituting values

$$= \frac{2}{\pi}\left[\frac{3\pi^2\sin(n\pi)}{n} + \frac{6\pi(\cos(n\pi))}{n^2} - \frac{6\sin n\pi}{n^3}\right] -$$

$$f(x) = \pi^2 + \sum_{n=1}^{\infty}\frac{12(-1)^n}{n^2}\cos(nx)$$

Question No. 2

(Q2 A) Given,

If $I_n = \int_0^{\pi/4}\tan^n x\,dx$ prove $I_n = \frac{1}{n-1} - I_{n-2}$

We know that Formula :-

$$\int_0^{\pi/2}\sin^n x = \frac{(n-1)(n-3)(n-5)\ldots}{n(n-2)(n-4)(n-6)\ldots}$$

(Splitting tan)

$$I_n = \int_0^{\pi/4}\tan^{n-2}x\,.\,\tan^2 x\,.\,dx$$

$$= \left[\tan^{n-2}x.(\tan x+\sec x) - (n-1)\int(\tan x+\sec x)\right]$$

$$= \tan^{n-1}x.(\tan x+\sec x) - (n-1)\int(\tan x+\sec x).dx$$

$$= \frac{\tan^n x}{\tan x}.\tan x+\sec x - (n-1)\frac{\tan^n x}{\tan^2 x}\int(\tan x+\sec x)dx$$

we know that $I_n = \int_0^{\pi/4}\tan^n x$

= By substituting values we get

$$I_n = \frac{1}{n-1} - I_{n-2}$$

Question No. 3 (

(Q3A) Given,

eq^n ⇒ $y^2(4-x) = x(x-2)^2$ — (I)

$$4y^2 - xy^2 = x(x^2-4x+4)$$

$$4y^2 - xy^2 = x^3 - 4x^2 + 4x$$

$$4y^2 = x^3 - 4x^2 + 2xy^2 \quad \text{— (II)}$$

Symmetry :-

We can see that the power of y is even so, the curve is symmetric about x-axis

Origin :-

By putting $x+y=0$ i.e $f(0,0)$ we can find out that

$$y^2(4-x) = x(x-2)^2$$

put $x=0$, $y=0$

$= 0$

∴ Curve passes through the origin $(0,0)$

Tangent at origin :-

Lowest Degree (LD)

In eq (II) we can find out that LD is term $-4x = 0$

putting $-4x = 0$, we get

$x = 0$

~~LD for y is~~

∴ Tangent is at $x=0$

Intersection :-

For x-axis :-

By putting $y=0$, we get

$$x^3 - 4x = 0$$

$$x^2 = 4$$

$x = 2$ $(2,0)$

For y-axis :-

By putting $x=0$, we get

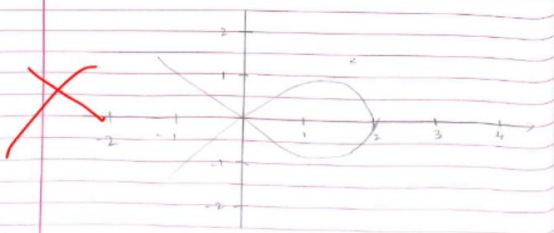
$$4y^2 = 0$$

$\therefore y = 0$ $(0,0)$

~~Cor~~ :- Region Of Existence :-

$$y^2 = \frac{x^3 - 4x + 2xy^2}{4}$$

$$y = \pm\frac{1}{2}\sqrt{x^3 - 4x + 2xy^2}$$



(Q3 B) Given eq^n

$r = a(1+\sin\theta)$ Cardioide

put or replace θ with $-\theta$, we get

$r = a(1+\sin(-\theta))$

$r = a(1-\sin\theta)$

∴ not symmetric to x-axis

replace θ with $(\pi-\theta)$, we get

$r = a(1+\sin(\pi-\theta))$

$r = a(1+\sin\theta)$

∴ It is symmetric to y-axis

Pole :-

For finding pole put $r=0$, we get

$0 = a(1+\sin\theta)$

$\sin\theta = -1$

$\theta = -\frac{\pi}{2}$

$$\tan\phi = \frac{r}{\frac{dr}{d\theta}} = \frac{a(1+\sin\theta)}{\cos\theta}$$

$$\Rightarrow \frac{dr}{d\theta} = a\left(\frac{d}{d\theta}(1) + \frac{d}{d\theta}(\sin\theta)\right)$$

$$= a(\cos\theta)$$

$$\tan\phi = \sec\theta + \tan\theta$$

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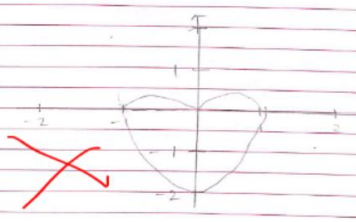

It is an candidate curve

Q3C) Given eqⁿ :-

$r = a\cos 3\theta$ → (1), rose curve

formula $r = a\cos n\theta$

where n = no. of petals

Symmetry :-

put $\theta = -\theta$ in eq (1)

$r = a\cos 3(-\theta)$

$\therefore r = a\cos 3\theta$

∴ The curve is symmetric about x-axis

No. of petals in this curve(n) = 3

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Pole

put $r = 0$

$0 = a\cos 3\theta$

$0 = \cos 3\theta$

$\cos^{-1}(0) = 3\theta$

$3\theta = \frac{\pi}{2}$

$\theta = \frac{\pi}{6} = 30°$ $\therefore \boxed{\frac{\pi}{6}, \frac{3\pi}{6}}$

~~The angles will change in ort-~~

we know n = 3

for half circle $= \frac{\pi}{3n} = \frac{180°}{3} = 60°$

Angles will increase by 60°

i.e. 60°, 120°, 180°

$\tan\phi = \frac{r}{dr/d\theta} = \frac{a\cos 3\theta}{3a\sin 3\theta} = \frac{1}{3}\cot(3\theta)$

$dr/d\theta = \frac{d(a\cdot\cos 3\theta)}{d\theta}$, by $u\cdot v = u\frac{dv}{dx} + v\frac{du}{dx}$

$= 3a\sin 3\theta + 0$

Table :-

θ	0	π/6	2π/6	3π/6	4π/6	5π/6	6π/6
r	0	−1	0	1	0		

∴ Curve

θ	6π/6	7π/6	8π/6	9π/6	10π/6
r	1	0	1	0	−1

θ	11π/6	12π/6
r	0	1

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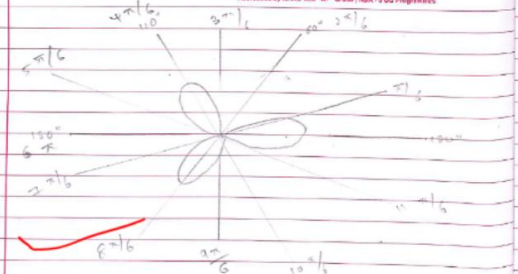

Question No. 2

Q2 B) $f(n) = e^{-n^2}$

Gamma function

~~f(n)~~ Put $n = t$

$n = t^{1/2}$

$\frac{dn}{dt} = \frac{1}{2}t^{-1/2}$

$\frac{dn}{dt} = \frac{1}{2\sqrt{t}}$

$\frac{dn}{dt} = \frac{dt}{2\sqrt{t}}$

put in limits $\int_0^\infty x^{1/2} e^{-x^2}$

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$\int_0^\infty (t^{1/2})^{1/2} = e^{-t^2}\cdot dt$

$= \frac{1}{2}\int_0^\infty t^{-1/2} e^{-t^2}\cdot dt$

we know that formula

$\int x^n \cdot e^{-x^2}\cdot dx = \lfloor n+1 \rfloor$

$\frac{1}{2}\int_0^\infty (t)^{-1/2}\cdot e^{-t}\, dt = \lfloor \frac{1}{4} \rfloor$

$\frac{1}{2} \times \lfloor \frac{3}{4} = \frac{1}{2}\lfloor \frac{3}{4}$

$\therefore f(n) = e^{-x^2} = \frac{1}{2}\lfloor \frac{3}{4}$

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Q2D) $I(a) = \int_0^\infty \frac{e^{-ax} - e^{-bx}}{x}\cdot dx$ → (1)

Differentiate on both side w.r.t a

$I'(a) = \int_0^\infty \frac{d}{da}\left(\frac{e^{-ax} - e^{-bx}}{x}\right)$

b, x is constant w.r.t a

$I'(a) = \int_0^\infty \frac{1}{x} - xe^{-ax} - 0$

$= \int_0^\infty \frac{1}{x^x} \times -x e^{-ax}$

$= \left[\frac{-e^{-ax}}{x}\right]_0^\infty$

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put $I(a) = 0$ in eqⁿ (3)

~~(3) = log x + c~~

~~x − c = − log x~~

put $a = 0$ in eqⁿ (3)

~~I(a) = log(0) + c~~ $I(0) = \log(a) + c$

~~0 = 1 + c~~ $c = -1$

$c = +1$

$I(a) = \log x + (\log x)\,1$

$$I'(a) = \left[\frac{-e^{-\infty}}{x} - \frac{-e^{0}}{x}\right]$$

$$I'(a) = 0 + \frac{1}{x}$$

Now integrate it again

$$I(a) = \int \frac{1}{x} = \log x + c \quad \text{--- (2)}$$

Now for c

put $a = b$ in eq^n (1)

we get $I(a) = \int_0^{\infty} \frac{e^{-bx} - e^{-bx}}{x} = \int_0^{\infty} 0 \, dx$

$\therefore I(a) = 0$

$\therefore I(a) = \log(x) + 1$

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Question No. 4

(Q4 C) $\int_{z=0}^{2}\int_{y=1}^{z}\int_{x=0}^{xyz} xyz \cdot dx \cdot dy \cdot dz$

$$\int_0^2\int_1^2\left[\int_0^{yz} x \cdot y \cdot z \cdot dx\right] \cdot dy \cdot dz$$

$$\Rightarrow \int_0^2\int_1^z \left[yz\left[\frac{x^2}{2}\right]_0^{yz}\right] \cdot dy \cdot dz$$

$$\Rightarrow \int_0^2\int_1^z \left[\frac{yzy^2z^2}{2} - 0\right] \cdot dy \cdot dz$$

$$\Rightarrow \int_0^2\left[\int_1^z \frac{y^3z^3}{2} \cdot dy\right] \cdot dz$$

$$\Rightarrow \int_0^2 \left[\frac{z^3y^4}{8}\right]_1^z \cdot dz$$

$$\Rightarrow \int_0^2 \left[\frac{z^3z^4}{8} - \frac{z^3(1)}{8}\right] \cdot dz$$

$$\Rightarrow \int_0^2 \left[\frac{z^7}{8} - \frac{z^3}{8}\right] \cdot dz$$

$$\Rightarrow \int_0^2 \frac{1}{8}\left[z^7 - z^3\right] \cdot dz$$

$$\Rightarrow \left[\frac{1}{8}\left[\frac{z^8}{8} - \frac{z^4}{4}\right]\right]_0^2$$

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$$\frac{1}{8}\left[\left[\frac{2^8}{8} - \frac{2^4}{4}\right] - 0\right]$$

$$= \frac{1}{8} \times \left[\frac{256}{8} - \frac{16}{4}\right]$$

$$= \frac{1}{8} \times \left[32 - 4\right]$$

$$= \frac{28}{8} = \frac{7}{2} = 3.5$$

$$= 3.5$$

$$\therefore \int_0^2\int_1^2\int_0^{yz} xyz \, dx \cdot dy \cdot dz = 3.5$$

$\therefore$ Total accumulated data intensity over given 3D computational region = 3.5

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(Q4 A) $\int_0^{x}\int_0^{\sqrt{y}} x \cdot dx \cdot dy$

Given $y = x^2$, $y = x$

$x = \sqrt{y}$

$$\int_0^{x}\left[\int_{x=0}^{x=\sqrt{y}} x \cdot dx\right] \cdot dy$$

$$\int_0^{x}\left[\frac{x^2}{2}\right]_0^{\sqrt{y}} \cdot dy$$

$$\int_0^{x} \frac{y}{2} \cdot dy$$

$$\left[\frac{y^2}{4}\right]_0^{x} \Rightarrow \frac{x^2}{4} - 0$$

$\therefore \iint x \cdot dx \cdot dy \Rightarrow \frac{x^2}{4}$ //

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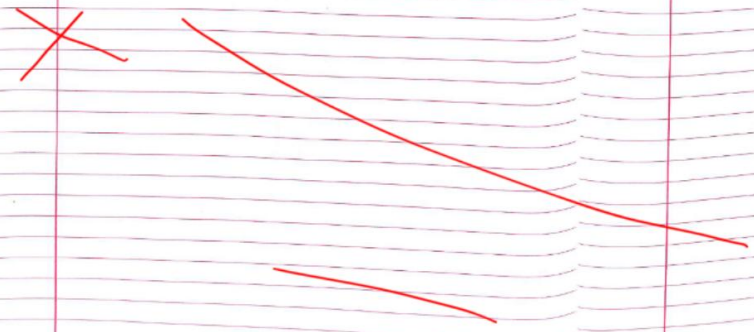
Q4 B) $r = a(1+\cos\theta)$

this is a cardioid curve

replacing θ with t

$r = a(1+\cos t)$



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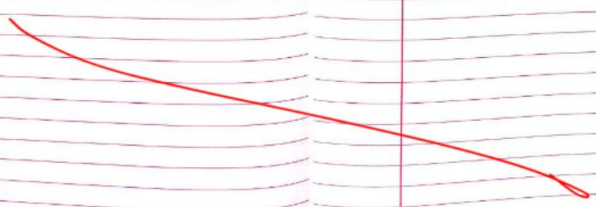

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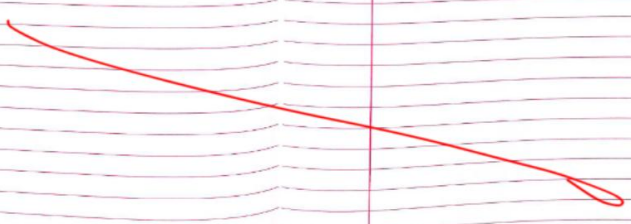

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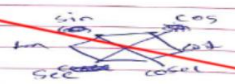
R.W

$$A = \begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix} - I$$

$f(n) \cdot \sin\frac{(n-1)\pi}{\lambda}$

$\pi n \cdot \sin\left(\frac{n\pi n}{2}\right)$

$\tan = \frac{\sin\theta}{\cos\theta}$



$\frac{1}{\cos}$